FIELDS

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OUTLINE

In this Outline we give a brief description of each item listed in the Contents. While the Contents and Index are quick ways to search, or learn the general layout of the book, the Outline gives more detail for the uninitiated. (The PDF version also allows use of the "Find" command in PDF readers.)

PART ONE: SYMMETRY

Relativistic quantum mechanics and classical field theory. Poincaré group = special relativity. Enlarged spacetime symmetries: conformal and supersymmetry. Equations of motion and actions for particles and fields/wave functions. Internal symmetries: global (classifying particles), local (field interactions).

PART TWO: QUANTA

Quantum aspects of field theory. Perturbation theory: expansions in loops, helicity, and internal symmetry. Although some have conjectured that nonperturbative approaches might solve renormalization difficulties found in perturbation, all evidence indicates these problems worsen instead in complete theory.

V. Quantization

Quantization of classical theories by path integrals. Backgrounds fields instead of sources exclusively: All uses of Feynman diagrams involve either S-matrix or effective action, both of which require removal of external propagators, equivalent to replacing sources with fields.

A. General

various properties of quantum physics in general context, so these items need not be repeated in more specialized and complicated cases of field theory

B. Propagators

relativistic quantum mechanics, free quantum field theory

PART THREE: HIGHER SPIN

General spins. Spin 2 must be included in any complete theory of nature. Higher spins are observed experimentally for bound states, but may be required also as fundamental fields.

IX. General relativity

Treatment closely related to that applied to Yang-Mills, super Yang-Mills, and supergravity. Based on methods that can be applied directly to spinors, and therefore to supergravity and superstrings. Somewhat new, but simplest, methods of calculating curvatures for purposes of solving the classical field equations.

A. Actions

starting point for deriving field equations for gravity (and matter)

1. **Gauge invariance** 587
   curved (spacetime) and flat (tangent space) indices; coordinate (spacetime) and local Lorentz (tangent space) symmetries
2. **Covariant derivatives** 592
   gauge fields: vierbein (coordinate symmetry) and Lorentz connection; generalization of unit vectors used as basis in curvilinear coordinates; basis for deriving field strengths (torsion, curvature), matter coupling; Killing vectors (symmetries of solutions)
3. **Conditions** 598
   gauges, constraints; Weyl tensor, Ricci tensor and scalar
4. **Integration** 601
   measure, invariance, densities
5. **Gravity** 605
   pure gravity, field equations
6. **Energy-momentum** 609
   matter coupling; gravitational energy-momentum
7. **Weyl scale** 611
   used later for cosmological and spherically symmetric solutions, gauge fixing, field redefinitions, studying conformal properties, generalization to supergravity and strings

B. Gauges

coordinate and other choices

1. **Lorenz** 620
   globally Lorentz covariant gauges, de Donder gauge; perturbation, BRST
2. **Geodesics** 622
   straight lines as solutions for particle equations of motion; dust